GAU 2611

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Ingrid Zulma Benoit VAN DE VOORDE, et al. Attorney Docket Q62184

Appln. No.: 09/737,547 Group Art Unit: 2611

Confirmation No.: 1517 Examiner: Not yet assigned

Filed: December 15, 2000

For: METHOD TO DIVIDE UPSTREAM TIMESLOTS IN A TIME DIVISION MULTIPLEX ACCESS SYSTEM, RELATED LINE TERMINATOR AND RELATED NETWORK TERMINATOR

SUBMISSION OF PRIORITY DOCUMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Submitted herewith is a certified copy of the priority document on which a claim to priority was made under 35 U.S.C. § 119. The Examiner is respectfully requested to acknowledge receipt of said priority document.

Respectfully submitted,

David J. Cushing
Registration No. 28,703

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Enclosures: **CERTIFIED COPY OF EUROPEAN PATENT APPLICATION NO. 99403274.6**

Date: March 7, 2001

CERTIFIED COPY OF
ORITY DOCUMENT

THIS PAGE BLANK (USPTO)

09/737,547
Q62784
181

Europäisches Patentamt | European Patent Office | Office européen des brevets

Bescheinigung | Certificate | Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. | Patent application No. | Demande de brevet

99403274.6

CERTIFIED COPY OF
PRIORITY DOCUMENT

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

I.L.C. HATTEN-HECKMAN

DEN HAAG, DEN
THE HAGUE, 29/01/01
LA HAYE, LE

Europäisches Patentamt
European Patent Office
Office européen des brevets

Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

Anmeldung Nr.:
Application no.:
Demande n°: 99403274.6

Anmeldetag:
Date of filing:
Date de dépôt: 23/12/99

Anmelder:
Applicant(s):
Demandeur(s):
ALCATEL
75008 Paris
FRANCE

Bezeichnung der Erfindung:
Title of the invention:
Titre de l'invention:
Method to divide upstream timeslots in a time division multiple access system, related line terminator and related network terminator

In Anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

Staat: State: Pays:	Tag: Date: Date:	Aktenzeichen: File no. Numéro de dépôt:

Internationale Patentklassifikation:
International Patent classification:
Classification internationale des brevets:
H04Q11/04, H04J3/16

Am Anmeldetag benannte Vertragstaaten:
Contracting states designated at date of filing: AT/BE/CH/CY/DE/DK/ES/FI/FR/GB/GR/IE/IT/LI/LU/MC/NL/PT/SE/[redacted]
Etats contractants désignés lors du depôt:

Bemerkungen:
Remarks:
Remarques:

Method to divide upstream timeslots in a time division multiple access system, related line terminator and related network terminator

The present invention relates to a method to divide upstream timeslots in a time division multiple access system as specified in the non-characteristic part of claim 1 and to a related line terminator and a related network terminator as specified in the characteristic parts of claims 2 and 3.

Such a method and the related network and line terminators are already known in the art, e.g. from the *"ITU-T Recommendation G.983.1 (10/98) section 8.3.5"*. Therein, it is explained how grants should be included in Physical Layer Operation and Maintenance (PLOAM) cells for sending from a line terminator in a Passive Optical Network (PON) system to a plurality of network terminators of the system to indicate to the network terminators what upstream time slot they can use for transmission of data to the line terminator. The systems described in the recommendation are more specifically 155/155Mbit/sec and 622(downstream)/155Mbit/sec systems wherein upon detection of its identity in a received grant, a network terminator can use a 155Mbit/s frame to send upstream data.

In order to support higher rates upstream, the same principle as described above could be used, i.e. sequential allocation of grants in the PLOAM cells to allow network terminators to use f.i. 622 Mbit/sec upstream timeslots. However, such a system would not be compatible with a 622/155 Mbit/sec system since the frame structures would not map.

An object of the present invention is therefore to provide a method and a related line terminator and network terminator of the above known type but which would allow graceful upgrade of the existing systems to higher upstream speeds.

According to the invention, this object is achieved by means of a method, a line terminator and a network terminator according to claim 1, 2 and 3 respectively wherein network terminators transmitting at higher speed, e.g. 622 Mbit/sec are called higher order network terminators and network terminators

sending at lower upstream speed, e.g. 155 Mbit/sec, are called lower order network terminators.

Indeed, by, in case of higher order network terminators, using in addition to the normally available grants, i.e. grants located at a predefined first place, called non-idle grants in the above Recommendation, additional grants, i.e. grants located at a predefined second place, in the above Recommendation called idle grants, and by adequately subdividing the existing upstream timeslots in subslots, higher rates can be supported whilst still being able to support the lower order network terminators. E.g. in case of a combination of a 622/155 Mbit/sec and a 622/622 Mbit/sec system, the network terminators sending at the former speed will upon receipt of a grant located at the predefined first place (non-idle grant place) use the complete 155 Mbit/sec upstream frame, whilst in the latter system, the network terminators upon receipt of a grant located either at a predefined first or at a predefined second place (idle grant place) will use a subframe being 1/4 th of the 155 Mbit/sec one.

Upstream frames used by lower order network terminators are called lower order timeslots, whilst slots used by a higher order network terminator are called higher order timeslots, these slots being in fact subslots of the upstream slots having the size of lower order timeslots.

It should further be noticed that the term "including", used in the claims, should not be interpreted as being limitative to the means listed thereafter. Thus, the scope of the expression "a device including means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

The above and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings wherein:

FIG. 1 shows a block scheme of an embodiment of a time division multiple access network wherein the method of the invention is used;

Fig 2 shows a downstream frame format and an upstream frame format used by the time division multiple access network of Fig. 1.

Referring to Fig. 1 a method to divide upstream timeslots used in a time division multiple access network in order to support 622/155 Mbit/sec as well as 622/622 Mbit/sec will be described. The working of the time division multiple access network will be explained by means of a functional description of the blocks shown in Fig. 1. Based on this description, implementation of the functional blocks in Figure 1 will be obvious to a person skilled in the art and will therefor not be described in detail.

The time division multiple access network includes a line terminator LT and a plurality of network terminators NT1, NT2, NT3, ..., NT15, NT16. The line terminator LT is coupled to each network terminator NT1, NT2, NT3, ..., NT15, NT16 via the cascade connection of a common transmission link Lc and an individual user link L1, L2, L3, ..., L15, L16.

The time division multiple access network is an optical network transporting f.i. asynchronous transfer mode ATM cells over optical fibers from the line terminator LT to the network terminators NT1, NT2, NT3, ..., NT15, NT16. The time division multiple access network broadcasts network terminator identities e.g. TEA1, TEA12, TEA16, TEA3, TEA7, ... or grants in downstream information packets form the line terminator LS to the plurality by network terminators NT1, NT2, NT3, ..., NT15, NT16. Upon detection of its own identity a network terminator is allowed to transfer a predetermined amount of upstream information packets in predetermined upstream timeslots to the line terminator LT. For example : upon detection of network terminator NT3 of its own identity TEA3, network terminator NT3 is allowed to send to the line terminator upstream information packets in predetermined timeslots.

The line terminator LT includes a packet formatting module PFM, inclusion means INC and queuing means Q. The queuing means Q is coupled to the inclusion means INC which is included following this embodiment in the packet formatting module PFM.

Each network terminator, whereof only network terminator NT3 is shown in detail in order not to overload the figure, includes recognition means REC and transmitting means TR.

The functions of each functional blocks of above will be described in the following paragraphs.

The line terminator allocates the time slots in a flexible and dynamically way. Indeed the upstream transfer capacity of the time division multiple access network is shared amongst the network terminators NT1, NT2, NT3, ..., NT15, NT16 based on their needed and requested upstream bandwidth to transmit upstream information. This needed upstream bandwidth is requested by the network terminators NT1, NT2, NT3, ..., NT15, NT16 to the line terminator LT. The requested bandwidth is translated by the line terminator LT in a predetermined number of allocated timeslots. This is realized by creating according the requested bandwidth of the network terminators NT1, NT2, NT3, ..., NT15, NTS16 a stream of transmit enable addresses or grants which are called in this application substation identities TEA1, TEA12, TEA16, TEA3, TEA7, ... and which correspond to the grants as specified in ITU-T Recommendation G.983.1. It has to be remarked that the detailed working of this allocation goes beyond the scope of this invention and is therefore not described. A detailed description of this working can be found in the published European patent application with publication number 0 544 975. The aim is the use of the stream of substation identities or grants TEA1, TEA12, TEA16, TEA3, TEA7, ... to inform the network terminators NT1, NT2, NT3, ..., NT15, NT16 of the allocated timeslots. Following this embodiment the stream of substation identities or grants TEA1, TEA12, TEA16, TEA3, TEA7, ... is provided to the inclusion means INC by the queuing means Q.

Physical Layer Operation and Maintenance cells, shortly PLOAM cells, are also provided to the inclusion means INC. The inclusion means INC inserts in the PLOAM cells the grants and the PLOAM cells are then included in the downstream information packets. In order to explain the subject method, it is supposed that network terminator NT2 is a lower order network terminator, i.e. a

network terminator sending at 155 Mbit/sec, whilst network terminator NT3 is a higher order network terminator sending at 622 Mbit/sec and that the downstream speed is 622 Mbit/sec.

Referring to figure 2 the downstream frame format and the upstream frame format used by the time division multiple access network of Figure 1 is shown. As it can be seen on figure 2, after 27 ATM cells a PLOAM cell is inserted.

NT2 being a lower order network terminator, the inclusion means INC inserts a grant TEA2 for this terminator in PLOAM 1 or PLOAM 2 at the location of non-idle grants as specified in ITU-T Recommendation G.983.1, version 10/98 on pages 39 and 41. It is supposed here as shown in Fig.2 that at a chosen point in time a grant for NT2 is included in PLOAM1. Grants for NT3 which is a higher order network terminator are included at the place of non-idle grants and of idle grants. It is supposed here that grants are inserted in PLOAMS 1 and 3. How many grants are included depends as mentioned earlier on the bandwidth requested by the network terminators. The queuing means Q provides the grants to be included to the including means INC in a sequence which depends on the allocated bandwidth. Since the way in which the number and sequence of allocated grants is determined is outside of the scope of the current invention, this is not explained in detail. Examples of how this is done can be found in the earlier mentioned patent application and in EPA 0854659.

The PLOAM cell after inclusion of the network terminator grants is shown in Fig. 1 as PLOAM'. The PLOAM cell is packed by the packet formatting module PFM into the downstream frame format and distributed to the plurality of network terminators. A network terminator has to detect its own identity in a received PLOAM cell in order to be allowed to transfer an upstream information packet. This is realized by the detecting means DET. The sending of the upstream information packets is done by the transmitting means TR. In order not to overload figure 1 only for network terminator NT3 the detecting means DET(TEA3) and the transmitting means (TR) is shown. Taking as example the downstream frame of Fig. 2, NT2 first recognises its identity in a non-idle grant

location of PLOAM1, and being a lower order network terminator, it then transfers an information packet in a 155 Mbit/sec timeslot. The subsequent identity transferred by the line terminator is that of NT3, also in PLOAM 1. Upon detection of its own identity and knowing that it is an higher order network terminator, NT3 is allowed to transfer an upstream information packet in a subslot of an 155 Mbit/sec slot being $1/4^{th}$ thereof. In order not to have gaps in the upstream frames, the line terminator has included a subsequent grant for NT3 in PLOAM3 at the location of an idle grant. Upon detection of its identity, NT3 sends an upstream information packet in a subsequent subslot as shown in Fig. 2. In this way, NT3 is enabled to send upstream information packets at 322 Mbit/s, whilst NT2 sends at 155 Mbit/s, and only one frame format is used which is suited for both speeds.

It should be noted that although the above described network of the chosen embodiment is an asynchronous transfer mode ATM network the application of the present invention is not restricted to the field of ATM. Small modifications, evident to a person skilled in the art may be applied to the above described embodiment to adapt it to be method to divide upstream timeslots integrated in other time division multiple access networks wherein physical layer operation and maintenance parts are predefined in downstream information packets.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention, as defined in the appended claims.

CLAIMS

1. Method to divide upstream timeslots in a multiple access system that couples a line terminator (LT) via a tree-like network to a plurality of network terminators (NT1, NT2, ..., NT16) and that distributes downstream data packets by said line terminator (LT) to said plurality of network terminators (NT1, NT2, ..., NT16), said method including the steps of :

- inclusion by said line terminator (LT) in a downstream data packet at a predefined place of a grant (TEA1, TEA2, ..., TEA16) being associated to one of said plurality of network terminators (NT1, NT2, ..., NT16) and distributing said downstream packet, and

- reacting by each one of said network terminators (NT1, NT2, ..., NT16) upon reception and recognition of its own grant by transmitting an upstream data packet in a predefined upstream timeslot,

characterised in that said step of transmitting includes,

- in the event when said one of said network terminators is a lower order network terminator and said predefined place is a predefined first place, transmitting said upstream data packet in a lower order timeslot,

- in the event when said one of said network terminators is a higher order network terminator and said predefined place is a predefined first place, transmitting said upstream data packet in one of a plurality of higher order timeslots, said higher order timeslots being subslots of a predefined number of higher order subslots included in said predefined upstream timeslot, and

- in the event when said one of said network terminators is a higher order network terminator and said predefined place is a predefined second place, transmitting said upstream data packet in a said higher order timeslot.

2. A line terminator (LT) for realising division of upstream timeslots in a time division multiple access system that couples said line terminator (LT) via a tree-like network to a plurality of network terminators (NT1, NT2, ..., NT16) and wherein said line terminator (LT) distributes downstream data packets to said plurality of network terminators (NT1, NT2, ..., NT16) said line terminator (LT) comprising :

- inclusion means (INC) adapted to include in a downstream data packet at a predefined first place a grant (TEA1 ; TEA2 ; ....; TEA16) associated to one of said plurality of network terminators, characterized in that

- said inclusion means (INC) is further adapted in the event when one of said plurality of network terminators (NT3) is a higher order network terminator to include at a predefined second place of said downstream data packet a grant (TEA3) being associated to said one of said plurality of network terminators (TEA3).

3. A network terminator (NT3) for use in a time division multiple access system that couples a line terminator (LT) via a tree-like network to a plurality of network terminators (NT1, NT2, ..., NT16) including said network terminator (NT3) said network terminator (NT3) comprising :

- recognition means (REC) to recognise its own grant (TEA3) in a downstream packet sent from said line terminator (LT) to said network terminator (NT3), and

- transmitting means (TR) to transmit a data packet in a predefined upstream timeslot upon recognition of said own grant (TEA3)

characterised in that said network terminator (NT3) is adapted to transmit upstream data packets at a higher order data packet rate and that therefor

- said recognition means (REC) is further adapted to recognise its own grant (TEA3) at a predefined first place and that said transmitting means (TR) is adapted, upon recognition by said recognition means (REC) of said own grant (TEA3) at said predefined first place to transmit data packet in one of a plurality of higher order timeslots, said higher order timeslots being a subslot of a predefined number of higher order subslots included in said predefined upstream timeslot, and

- said recognition means (REC) being further adapted to recognise its own grant (TEA3) at a predefined second place and that said transmitting means (TR) is further adapted, upon recognition by said recognition means (REC)

of said own grant (TEA3) at said predefined second place, to transmit said data packet in a said higher order timeslot.

4.Method according to claim 1, characterized in that said time division multiple access system is a Passive Optical Network (PON) system and that said downstream data packets are Physical Layer Operation and Maintenance (PLOAM) cells.

5. Method according to claim 4, characterized in that said first predetermined place is a location within said Physical Layer Operation and Maintenance (PLOAM) cells reserved for so-called non-idle grants as specified in the ITU-T Recommendation G.983.1, whereas said second predetermined place is a location within said Physical Layer Operation and Maintenance (PLOAM) cells reserved to idle grants as specified in the ITU-T Recommendation G.983.1.

ABSTRACT

Method to divide upstream timeslots in a time division multiple access system, related line terminator and related network terminator

A method to divide upstream timeslots in a multiple access system that couples a line terminator (LT) via a tree-like network to a plurality of network terminators (NT1, NT2, ..., NT16) and that distributes downstream data packets by the line terminator to the plurality of network terminators. The method includes the following steps :

- inclusion by the line terminator in a downstream data packet at a predefined place of a grant (TEA1 ; TEA2 ; ... ; TEA16) being associated to one of the plurality of network terminators and distributing that downstream packet,

- reacting by the network terminator upon reception and recognition of its own grant by transmitting an upstream data packet in a predefined upstream timeslot.

In the event when the network terminator is a lower order network terminator and the predefined place is a predefined first place, the upstream data packet are transmitted in a lower order timeslot.

In the event when the network terminator is a higher order network terminator and the predefined place is a predefined first place, the upstream data packet is transmitted in one of a plurality of higher order timeslots, where the higher order timeslots are subslots of a predefined number of higher order subslots included in the predefined upstream timeslot.

In the event when the network terminator is a higher order network terminator and the predefined place is a predefined second place, the upstream data packet is also transmitted in such higher order timeslot.

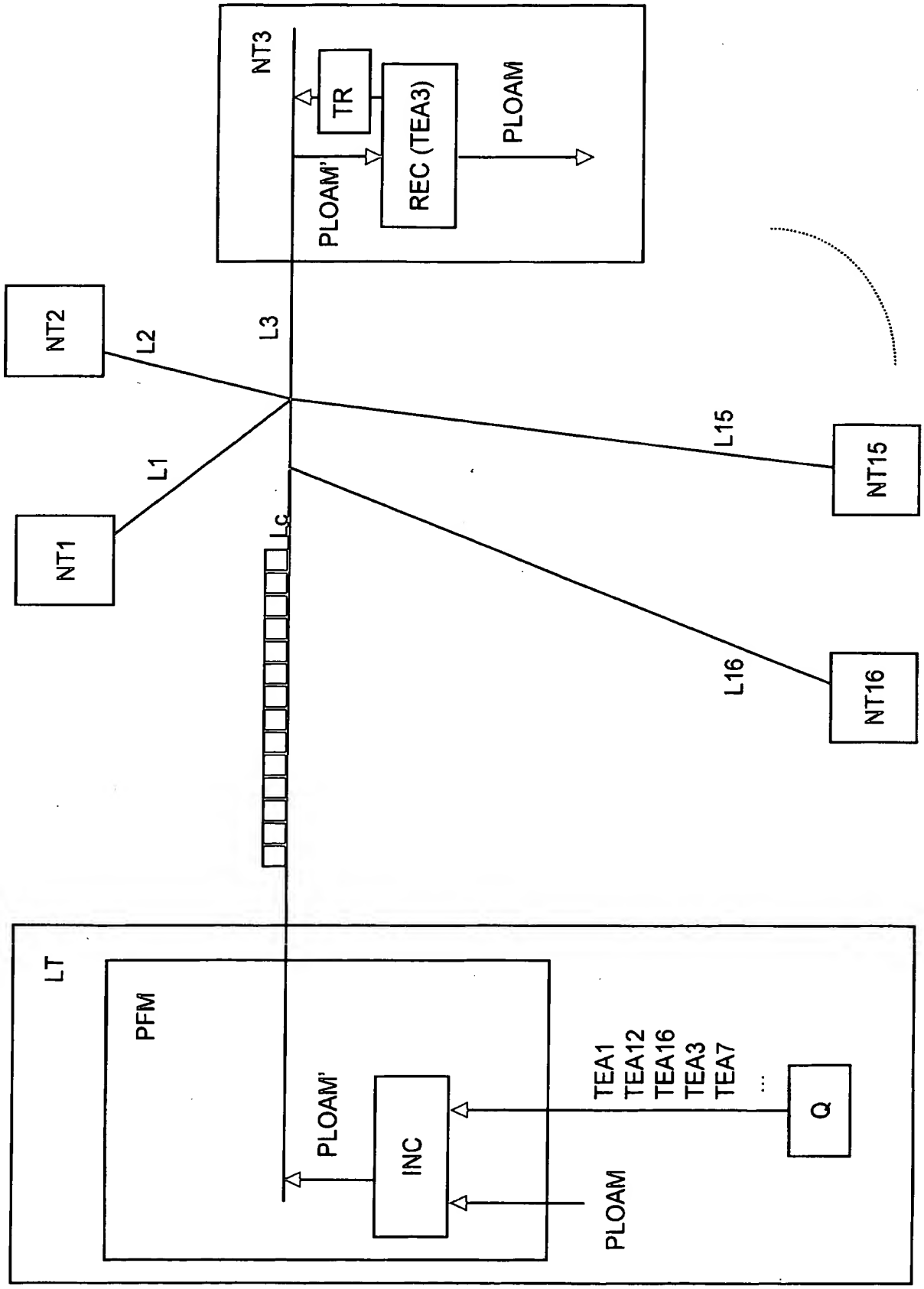
NT3
TR
REC (TEA3)
PLOAM
PLOAM'
NT2
L2
L3
L15
NT15
L1
NT1
Lc
L16
NT16
LT
PFM
PLOAM'
INC
TEA1
TEA12
TEA16
TEA3
TEA7
...
Q
PLOAM

FIG 1

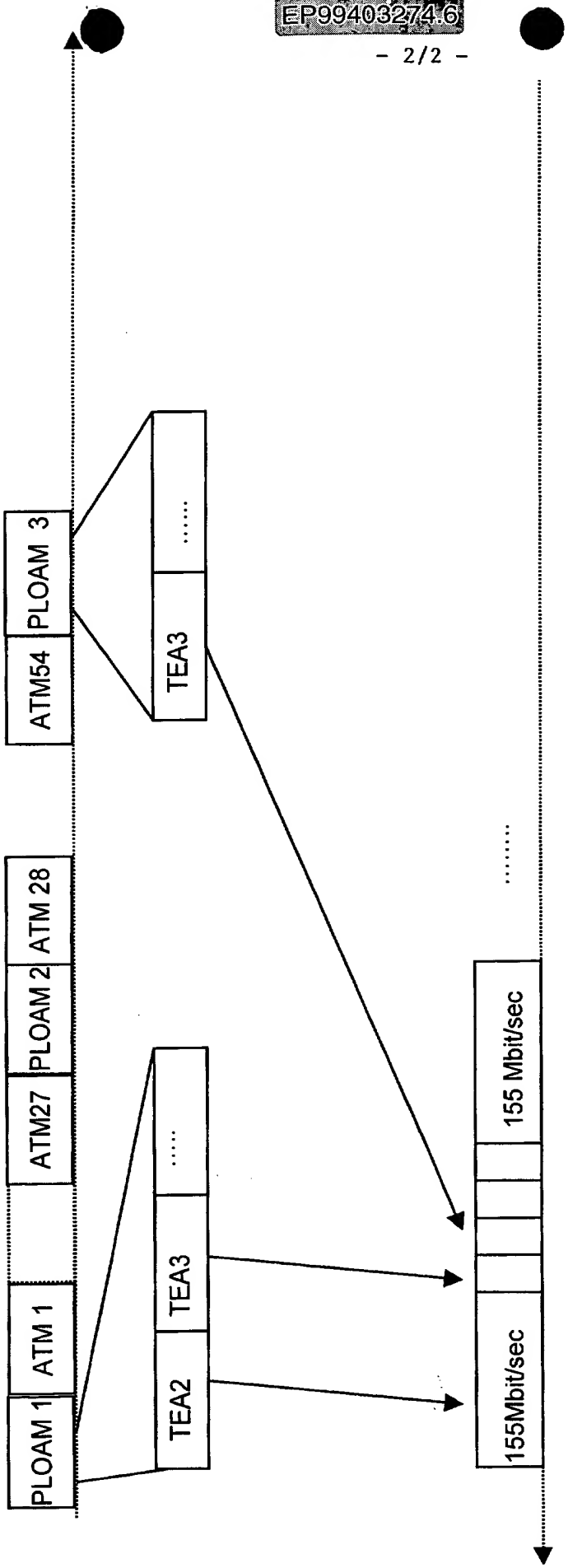
PLOAM 1
ATM 1
ATM27
PLOAM 2
ATM 28
ATM54
PLOAM 3
TEA2
TEA3
.....
TEA3
.....
155Mbit/sec
155 Mbit/sec
.....

Fig. 2